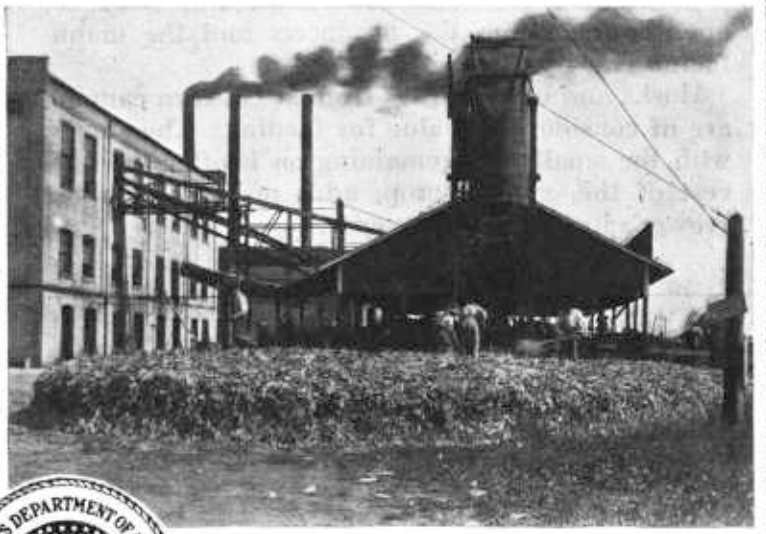
U. S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN No. 1634
rev. Oct. 1936

GROWING SWEET CORN *for the* CANNERY



SWEET CORN, which ranks among the three most important canned vegetable commodities, is produced commercially in several of the Northern States. It is a tender annual plant easily injured by frost and will not withstand excessive heat. Its production is therefore limited to those sections where there is a minimum frost-free season of 85 to 120 days.

The successful production and canning of sweet corn on a commercial scale requires favorable soil, climatic and economic conditions, and close cooperation between the producers and the manufacturers.

Husks and other wastes from sweet-corn canning are of considerable value for feeding. The stover, with the small ears remaining on it after the harvest of the canning crop, adds materially to the grower's income from the crop.

Washington, D. C.

Issued December 1930
Revised October 1936

GROWING SWEET CORN FOR THE CANNERY

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IMPORTANCE AND DISTRIBUTION OF SWEET-CORN GROWING FOR THE CANNERY

Sweet corn, which ranks among the three most important canned vegetable commodities, is produced in commercial quantities in several States in the northern half of the United States. Its production is highly developed in Iowa, Illinois, Maryland, Ohio, New York, Indiana, and Maine, and to a lesser extent in Minnesota, Wisconsin, Michigan, Nebraska, and Pennsylvania. Production of this crop has varied considerably in recent years. The production in 1933 and 1934 was approximately 395,000 tons and 495,000 tons, respectively, while the average production for the years 1928 to 1932 was 628,000 tons. The acreage in 1933 and 1934 devoted to the crop was approximately 200,000 acres in 1933 and 287,000 acres in 1934, while the average for the years 1928 to 1932 was approximately 314,000 acres.

CLIMATIC REQUIREMENTS

Climatic and soil conditions have influenced to a large degree the growth of the sweet-corn canning industry in the areas mentioned. Sweet corn is a tender annual plant, easily injured by frost, and one that will not withstand excessive heat. This fact limits its produc-

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tion to those sections where there is a minimum frost-free season of from 85 to 120 days within which suitable varieties may be grown. The spring months should be sufficiently warm so that the corn will make a rapid and uninterrupted growth; but excessively hot weather during the summer months, especially when accompanied by drought, may cause premature ripening and low yields. Cool summer weather has a tendency to retard the ripening of the kernels, extending the period through which the ears are in edible condition. An average annual rainfall of about 40 inches, properly distributed throughout the year, will supply enough water for bringing the crop to the proper stage of maturity for canning.

ECONOMIC CONSIDERATIONS

The canning of corn economically and in conformity with modern standards of quality requires expert supervision and a large investment in factory equipment. This necessitates operations on a rather large scale if the enterprise is to be profitable. With a large investment in equipment and the need for employing a great deal of labor, factory operation is costly. If a corn canner is to operate his business successfully, he must be able to obtain an adequate supply of high-quality corn at prices that will leave him a reasonable margin of profit after he has disposed of his pack upon markets in which competition is keen and prices are often unstable.

It is obvious that if the farmer is to profitably grow corn for the cannery, he must receive a reasonable return for his labor and upon his investment in land and equipment.

These conditions preclude the successful operation of a corn-canning establishment in a region where good yields cannot be obtained by the farmer. Canner and farmer are interdependent and will succeed or fail together. Operations should be attempted only in regions where good yields can be obtained on lands of medium value. An adequate acreage must be available to yield a sufficient quantity of corn to keep the factory in full operation for a reasonably long canning season. Moreover, climatic conditions must be such that corn of uniformly high quality can be delivered.

Sweet corn may be successfully produced in growing seasons too short for the maturing of most varieties of field corn. It fits well into the farm-crop rotation and occupies the land a shorter time than certain other crops, giving an opportunity for an increased use of green manure and cover crops. Since cannery corn is usually grown under contract and delivered as soon as harvested, marketing and storage problems are eliminated. The stover and cannery wastes afford a supply of succulent roughage for livestock at a period when other sources of such feed are often scarce.

METHODS FOLLOWED BY CANNERS TO PROVIDE FOR SUPPLIES OF SWEET CORN

In the Eastern States most of the sweet-corn crop is raised by numerous growers in small fields of a few acres each, whereas in the Corn Belt there are factories each of which operates several thousand acres devoted mainly to sweet corn. Probably three-fourths of the green corn packed is grown under contract by individual growers.

Contracts are made some months before planting time, sometimes on a sliding scale, but oftener at a stipulated price per ton for a given variety. The tonnage may be based upon corn in the husk or upon husked corn. The variety and the acreage are specified for each grower, sometimes with a clause relative to separate plantings at stated intervals. The seed is usually furnished by the company. The grower usually agrees to separate the different varieties of sweet corn from one another or from field corn by a stated distance, to plant carefully, to cultivate thoroughly, and to keep the fields free from weeds until the crop is ready to harvest. The crop must be harvested in the milk stage. The ears are snapped or cut off with the minimum amount of shank and are delivered to the factory on the same day they are harvested, before the corn has become heated or otherwise damaged. The waste products, including the husks and cobs, usually belong to the company, although some of this material may be returned to the producer for immediate feeding (fig. 1).

FIGURE 1.—Sweet-corn husks and cobs being returned to the farmer for feeding.

SOIL AND FERTILITY REQUIREMENTS

SOILS

Sweet corn is produced on soils similar to those used for field corn, but the crop is more exacting as to the conditions under which it is most successfully grown. A well-drained, medium heavy loam, abundantly supplied with organic matter, will probably give the best results. Where heavy clays are used their physical character should be improved by turning under large quantities of manure and cover crops. Moderately heavy soils are preferred, since they are more retentive of moisture and the crop is less liable to suffer from drought during the latter part of the growing season. These soils cannot be worked as early as the lighter soils, but that is no particular disadvantage, because earliness usually is not a very important factor with the canning crop.

CROP ROTATION

Crop rotation is considered essential to continued success in modern farming. It is one of the requisites for improving worn-out soils and for maintaining soil fertility. It tends to prevent the exhaustion of any one particular element of plant food, and is an aid in holding in check certain insects, diseases, and weeds.

It is impossible to suggest rotations suitable to all sections, but one that brings sweet corn on the same ground not more than once every 4 years is most desirable. Such a rotation should include a sod crop, preferably clover or clover and timothy. This combination can occupy the land for 2 years and then be followed by sweet corn. Some cover crop, such as crimson clover, may be sown at the time the corn is given its last cultivation, or rye or barley may be seeded after the corn is harvested. These are turned under the following spring before such plantings as peas or oats. A green-manure crop, such as cowpeas or soybeans, may be sown at the last cultivation of the sweet corn and turned under after harvest but before frost. In other cases a grain, such as winter wheat, either alone or with grass, may be seeded in the corn stubble. When two grain crops appear in the rotation, such as oats followed by wheat, grass seed is combined with the latter for the subsequent hay and pasturage. The rotation must be planned to suit the locality, the soil, and the general type of farming.

In certain canning-crop regions tomatoes, peas, snap beans, or lima beans, as well as corn, are grown. In such regions a rotation similar to the following is common:

First year, sweet corn followed by a rye or rye and vetch cover crop to be turned under in the spring.
Second year, tomatoes.
Third year, peas followed by beans.
Fourth year, wheat followed by grass.
Fifth year, hay.

GREEN MANURE

Rotations should include rapidly growing, short-season crops of either leguminous or nonleguminous plants that are plowed under for green manure. The legumes are an advantage in that when the proper nitrogen-fixing bacteria are present in the soil nitrogen is removed from the air under favorable conditions and is made available for plant growth. Whenever practicable the land should be protected from erosion over winter by a cover crop that may be turned under in the spring. Winter cover crops, such as rye, should be turned under before they have become tall and strawy, as material of this character, if plowed under immediately before planting, is liable to rob the crop of nitrogen. The application of succulent plant material to the soil adds organic matter, improving both the physical and the chemical character of the soil and promoting the growth of helpful soil bacteria. These crops are also an aid in suppressing weed growth.

STABLE MANURE

Heavy yields of sweet corn of high quality are secured only when the soil contains an abundance of readily available plant food. This, in part, can be obtained from stable manure, which is one of

the most valuable of all fertilizing materials. Not only does barnyard manure contain most of the food elements required by plants, but it also has a markedly beneficial effect upon the physical condition of the soil. The plant-food value of manure depends upon the source and upon the conditions under which it has been kept. Manure that has been exposed to weathering and to other unfavorable conditions may have lost the greater portion of its fertility and may be of value only for the organic matter contained. Unleached manure, therefore, is preferable because of its additional plant food.

On soils suitable for the growing of sweet corn, dressings of from 10 to 12 tons of good quality stable manure should give good results. As a rule it is most economically applied with a manure spreader. Unless the manure can be stored so that it will not deteriorate, it is better to distribute it as produced. The greatest value will doubtless be obtained by spreading rotted manure on plowed land, to be worked in by disking at the time the soil is prepared for planting. Large quantities of coarse, strawy manure should not be applied immediately before a crop is planted, but preferably should be turned under the previous fall.

FERTILIZERS

Commercial fertilizers alone are insufficient to give good crops of sweet corn. Such fertilizers should supplement rather than supplant animal and green manures. The kind and quantity to be used are dependent upon the needs of the soil and the quantity of stable manure previously applied. A sufficient quantity should be used to maintain high production, and such applications should be made before the crops show a marked reduction in yield. Each grower must determine the particular kind and the quantity of fertilizer required for the best results under his own soil conditions. In general, a fertilizer containing from 4 to 5 percent nitrogen, 8 to 10 percent phosphoric acid, and 5 to 6 percent potash will be found satisfactory. The rate of application will vary from 200 to 600 pounds per acre, taking the lower quantity when barnyard manure is used. Superphosphate (16 percent phosphoric acid) applied with manure at the rate of 50 pounds per ton of manure has given good results.

Some growers have obtained superior results by applying the phosphoric acid and the potash-carrying materials at the time the soil is prepared for planting, and then applying the nitrogenous material as a side dressing later, at the time of the first cultivation. Although this practice seems to be very desirable from the standpoint of obtaining the best growth and highest yield, it should be pointed out that some extra equipment is needed, and it involves the additional labor of going over the field to apply the material. Although attachments are available for a number of standard makes of cultivators for applying top-dressing during cultivation, it remains for the individual grower to determine whether the additional labor and expense will yield sufficient gains to make this practice profitable.

Commercial fertilizers may be applied near the row, with a combination planter and fertilizer distributor, at the rate of 100 to 200 pounds per acre at planting time, but they should not come in con-

tact with the seed. If more than 200 pounds per acre is to be applied, the excess should be broadcast and worked in during the final fitting of the soil before planting.

LIME

Sweet corn is not particularly sensitive to soil acidity, but lime may be essential to some of the other crops in the rotation. Lime frequently improves the physical texture of soils, especially those of a clay nature, and also tends to liberate through its chemical action some of the plant nutrients of the soil. If the lime requirement is satisfactory for the legumes and other crops in the rotation, soil acidity will not be limiting factor in growing sweet corn.

PREPARATION OF THE LAND

Thorough preparation of the seed bed is a very important factor in obtaining high yields of sweet corn. It influences growth through its effect upon the penetration of the corn roots, the retention and supply of soil moisture, and, to a large extent, the cost of cultivation.

There is a great diversity of opinion as to the methods to be followed in the preparation of the soil, owing for the most part to the varied needs of soils, which differ widely in their physical nature. Fall plowing of all stiff and sod land, leaving the fitting until spring, affords a better seasonal distribution of farm labor. The exposure of such plowed land during winter improves the physical condition of the soil, assists in the decay of vegetable matter, and destroys the larvae of many insects. Fall plowing may be advisable where winter washing of the soil is not likely to occur, but it cannot be practiced when the land is occupied by winter cover crops. Spring plowing may be better with the lighter soils, especially when they are well drained. The depth of plowing will depend upon the nature of the land and the previous cropping system. It is a good practice on many soils to increase the depth of plowing one-half of an inch each season until a depth of 8 to 10 inches has been obtained. In fitting the land, the top layer should be thoroughly fined by disking and harrowing to a depth of at least 4 inches, and preferably deeper if possible (fig. 2). A good seed bed must be deep, well fined, and free from lumps or clods and weeds. A detailed discussion of the preparation of the land is given in Farmers' Bulletin 1714, Corn Culture.

SEED AND SEED IMPROVEMENT

Improvement of seed sweet corn by selection and modern methods of handling has been effective in increasing the yield and quality of this canning crop. Productive seed must be (1) of a high-yielding, uniform, high-quality strain and variety, (2) well adapted to the soil and climate where it is to be grown, (3) well matured and preserved from ripening time until planting time in a manner that will retain its full productivity, and (4) free from insects and diseases.

LOCALLY PRODUCED SEED

In most localities where sweet corn for canning is grown it is possible for individual growers or associations to produce and save seed. Seed produced locally by experienced growers can be made to con-

form more closely to the particular local requirements than most of the stocks obtained from unknown sources. The use of seed grown in the immediate section may lessen the risk from certain insects or diseases that might be brought in from distant sources. Seed corn from certain other regions may mature irregularly or yield poorly because it may not be adapted to the new conditions, although this is not always true.

In producing seed for large acreages it is advisable to maintain certain seed-growing plots or fields that can be given special attention rather than to save seed from a portion of the common run of corn as grown for the cannery. In developing such a source of seed the original selections from which it is to be grown may be taken from a field grown for canning, but subsequently these selections and their progenies should be subjected to further selection to elimi-

FIGURE 2.—Disking land for sweet corn.

nate undesirable characters, and they should be reasonably well isolated from less desirable strains that might cross-pollinate them.

This further selection should include the establishment of ear-to-row tests, in which the kernels of each ear are planted in separate rows so that the performance of each ear can be noted. Seed from only the best rows is saved, and the process is continued until the most desirable strains have been found, which can then be planted in increase plots for seed production for the general crop. The stock-seed plots must be gone over carefully each year for the purpose of eliminating undesirable plants; otherwise the strain will soon revert to less uniform and less desirable characteristics.

The details of the procedure of improving seed of sweet corn are essentially the same as for field corn, although different characteristics are considered in making the selections. The methods involved are fully described in Farmers' Bulletin 1175, Better Seed Corn.

A more technical presentation of the subject is given in Department Bulletin 1489, Corn Breeding.[1]

The selection of plants from which seed is to be saved should be made in the field at the time it is desirable to have corn of high quality available for harvest, or at the time when the plants are sufficiently mature to make the important characteristics discernible. If earliness is desired, stalks showing this character to a marked degree when compared with the average of the field should be selected; but premature ripening, which may result from injury, should not be mistaken for true earliness. Plants producing the highest yield of the best ears when growing in competition with a full stand of healthy plants are the ones to select. Other traits, such as drooping ears that shed the rain readily, ears that are borne at the proper height for snapping and also that are of a size and shape to permit efficient cutting in the factory, should be taken into consideration. From 14 to 18 pounds of corn on the ear are required to plant 1 acre. After estimating the requirements on the basis of total acreage, three or four times as many ears as are needed should be selected, so that sorting and grading of the stock can be done more carefully. The plants chosen for seed purposes should be marked with tags or pieces of bright-colored cloth so that in harvesting for the cannery these ears will be left to ripen thoroughly on the plant.

Care should be taken to harvest the seed ears before freezing weather and during a dry period, in order to prevent the reduction in vitality and productivity that follows exposure to low temperatures while the moisture content is high. Even when gathering is delayed until the stalks and leaves are dry, the ears still contain a large percentage of moisture. These ears should be placed immediately in a dry, ventilated storeroom where each ear will be fully exposed to the air. Seed sweet corn is frequently injured by heating when stored in piles. It spoils more quickly than field corn and cannot be readily cured in shocks.

It is best to employ some means for separating the individual ears. This can readily be done by stringing them together with twine, by sticking the butts on hooks made by cutting wire fencing, or by placing them on sets of wire-bottomed trays (fig. 3). Means should be provided to insure an even distribution and rapid circulation of the air and for its removal by ventilators or windows as soon as it becomes laden with moisture. Sometimes a little additional heat may be desirable to aid in drying the seed. For full directions for the curing and care of seed refer to Farmers' Bulletin 1175, Better Seed Corn.

COMMERCIAL SEED

Commercial seedsmen have given especial attention to the development of improved varieties of sweet corn and to the production of seed therefrom. Many firms make a special effort to maintain high-quality stocks of the important varieties, and these stocks will undoubtedly continue to be the main dependence of a large proportion of growers of canning-crop sweet corn.

[1] Out of print, but may be consulted in libraries.

VARIETIES

A fairly wide range of varieties has been used for canning, since style of preparation and handling has not had much influence on choice of corn. Until the last two decades only white corn was canned; at the present time, however, yellow varieties are increasingly used. The conditions that have determined which varieties should be canned have been climatic and economic.

If a flat price is given to the growers for corn delivered to the cannery, the grower will naturally desire to have the variety that gives the greatest tonnage per acre. The canner will choose the variety with the highest yield of canned corn per ton of raw stock. Therefore, where the climate allows, the variety chosen will be late

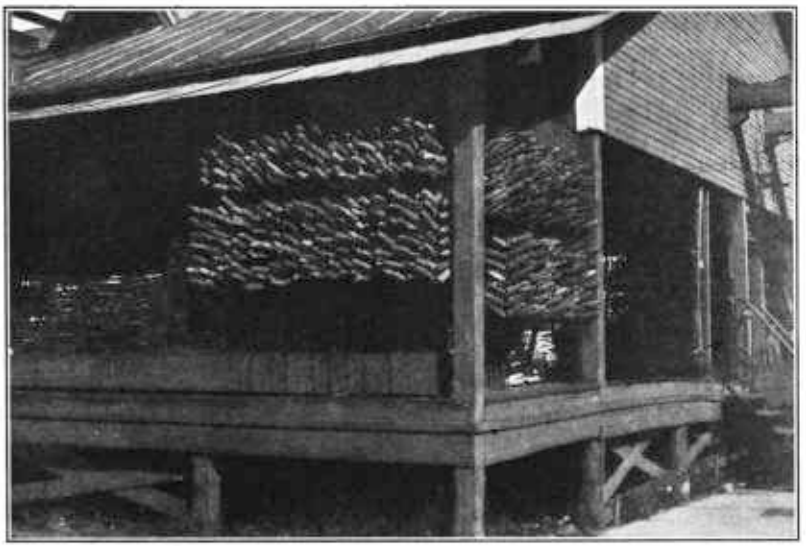

FIGURE 3.—Seed sweet corn drying on wire supports under an open shed.

and deep grained, since these varieties are more productive and will give the most cases per ton of ears. These considerations probably account for the use of Stowell Evergreen and Country Gentleman where the growing season is of sufficient length.

In some regions where these varieties are canned the summer temperatures are high and sweet corn passes its prime condition very rapidly. This makes the work of obtaining the finest grade of product more difficult. It is evident, therefore, that the canner who is located as far north as corn can be grown will have a longer period of time when his corn will be in prime condition, and with the same degree of careful attention he will be able to procure a better product than his competitor farther south. He cannot grow the late varieties, however, and must use earlier types of lower production. Crosby corn in the past has furnished most of the product for the northern packers. Since 1915 much more attention has been given to the canning of yellow varieties.

The influence of style of pack on varieties used has not been very great. Originally the grains of corn were cut from the cob by hand and were canned whole with the addition of a liquor containing sugar and salt. When machine cutters were devised the grain was cut across and much of the contents was scraped out, leaving a part of the skin of the grain attached to the cob. This made a more creamy product and did not require the addition of so much liquor to give a desirable consistency. While there has been some whole-grain corn packed at all times, by far the major part of the canned corn until very recently has been of the creamy type often spoken of as "Maine style." However, whole-grain corn is apparently coming into popularity again. Although any variety of corn may be canned in either of these two ways, small grains have been thought desirable for the creamy pack, and the selection of canning corns in recent years has tended to produce narrow-grained sorts.

In the past few years remarkable progress has been made by State and Federal research agencies and by private individuals and firms in the development of new hybrid and top-crossed sweet corns having high quality, improved uniformity, resistance to bacterial wilt (Stewart's disease), and much higher yielding capacity than the ordinary varieties. One of the most important of these, Golden Cross Bantam is briefly described below, along with other important canning sorts.

GOLDEN CROSS BANTAM

Golden Cross Bantam is a new hybrid yellow sweet corn of high quality, that is high yielding and resistant to bacterial wilt (Stewart's disease). It has quickly become a canning variety of major importance.

This hybrid cannot be reproduced from its own seed. It is produced only from crossed seed obtained by controlled cross-pollination of two inbred lines designated as Purdue Bantam and Purdue 51. These inbreds and the first cross were developed by the United States Department of Agriculture and the Purdue University Agricultural Experiment Station.

Golden Cross Bantam is similar to Golden Bantam in color and quality, but the plant is sturdier and plant and ears are larger. It is an early midseason sort, reaching the canning stage 85 to 95 days after planting in Indiana or States of similar latitude.

The stalks average about 6 feet tall but range from 4 to 7½ feet, depending on environment. Under favorable conditions two ears are produced on each stalk.

The ears are tightly covered by rather thin husks. The husked ears are about 8 inches long, nearly cylindrical, and have 10 to 14 straight or slightly winding rows of kernels. The white cobs taper slightly toward their well-rounded tips. At the canning stage the kernels are of medium size, somewhat narrower, and deeper than Golden Bantam kernels. They are light golden yellow and tender, and they harden less rapidly than Golden Bantam. The dry mature kernels are dark orange.

Crossed seed for the growing of this hybrid is now being produced in large quantities by a number of seed firms who make a specialty of sweet-corn seed for canners.

Golden Cross Bantam and its parents are discussed in detail in Circular 268, Golden Cross Bantam Sweet Corn.[2]

STOWELL EVERGREEN

Stowell Evergreen is a well-known variety, named before 1865. It has a wide range of variation. Its popularity has led to extensive selection, so that it becomes the parent of a number of named strains, such as Early Evergreen, Narrow-Grained Evergreen, White Evergreen, Zigzag Evergreen, and Club Evergreen.

Stowell Evergreen is medium to late in season. The stalk is sturdy, usually standing well, 7 to 8 feet tall. The ears are large, 14-rowed to 20-rowed, with kernels in rows (fig. 4). The grains are white, long, drying into a distinctive flattened shriveled shape, with the top usually bent in drying. The large size of the ear, its deep grain, and its productiveness are all valuable characters for a canning corn. It has the reputation of staying in prime condition longer than most varieties, and careful tests indicate that the claim is justified to some extent, but it is certain that claims for this character have often been exaggerated.

Most strains of Stowell Evergreen produce ears with a large number of rows and narrow grains. These types have been selected by a number of seed growers and experiment-station workers, so that there are several independent narrow-grained selections. These have been in much demand by canners, but some of them have failed to show the vigor and productiveness of the parent variety. It may be that the smaller size of the seed gives a less vigorous start and so handicaps the young plant.

Early Evergreen differs so much in the characters of the grain that it may well be a cross rather than a selection from Stowell Evergreen. The plant is shorter than Stowell and several days earlier, the ears are not so large, and the grains are not so deep and do not become so flat in ripening. It can be grown farther north than Stowell.

The other selections are not so much in favor with canners.

White Evergreen has been selected for a purer white color than the Stowell type.

Zigzag Evergreen is a fairly old selection in which the grains are arranged irregularly on the cob, showing no rows. It has been offered for sale by seedsmen for several years.

Club Zigzag has much the same character of grain as the last but has a larger ear, often flattened on the tip. It has been popular with market gardeners near Cincinnati, Ohio, but is not adapted for canning machinery. It has seldom, if ever, been offered by the seed trade.

COUNTRY GENTLEMAN

Country Gentleman when originally introduced, about 1882, carried the name of Ne Plus Ultra. It is also often called Shoepeg. It is a late variety, with stalks 7 feet high. The ears are often tapering and are 6 to 7 inches long. The grains are arranged so irregularly

[2] For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents.

that no rows are apparent from inspection of the husked ear. The grains are long and very slender and they shrivel on drying, similarly to the grains of Stowell Evergreen, rather than wrinkle like Crosby or Golden Bantam (fig. 5).

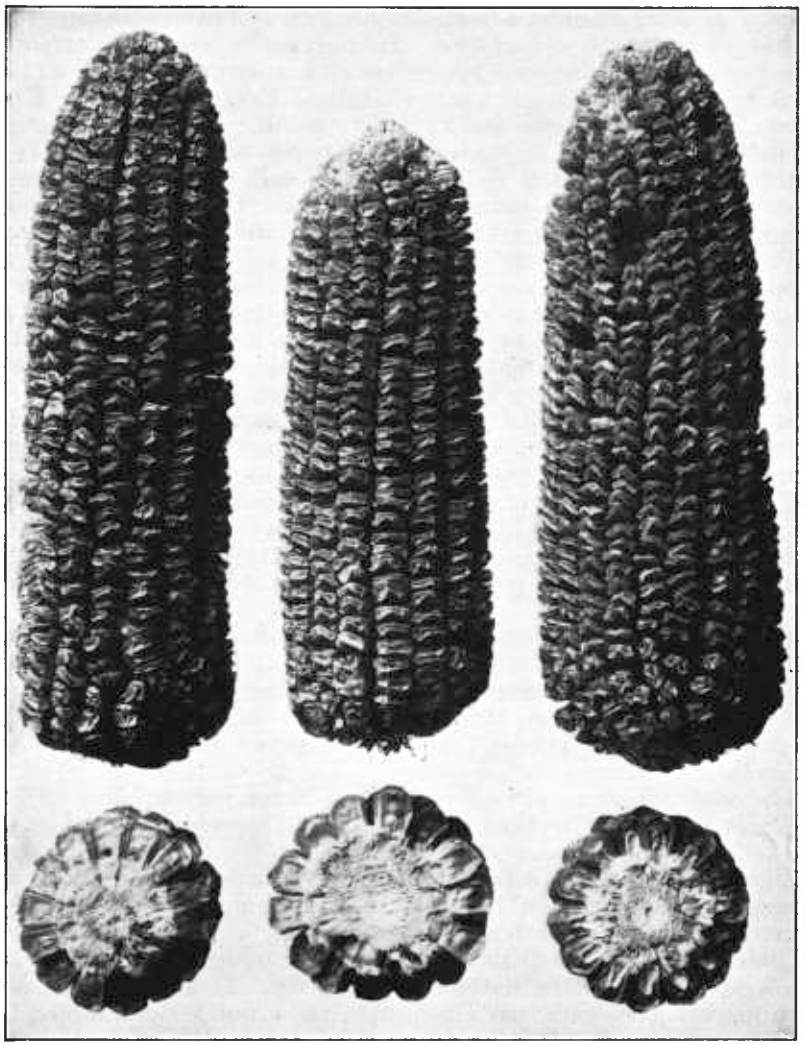

FIGURE 4.—Stowell Evergreen sweet corn. (One-half natural size.)

Country Gentleman has been popular as a canning corn because of its productiveness and its deep kernels, which give a high percentage of cut-off corn.

CROSBY

The Crosby variety was first introduced about 1860. It is an early white corn and has been very popular for canning in Maine and parts of Minnesota. Its fairly robust stalks are 5 to 6 feet high.

The ears are cylindrical, 5 to 6 inches long, with 12 to 16 rows of grains. The grains are closely wrinkled, square, and shallow (fig. 6).

It may be that part of the reputation for the high quality of northern sweet corn is due to the varieties used as well as to the more favorable climate.

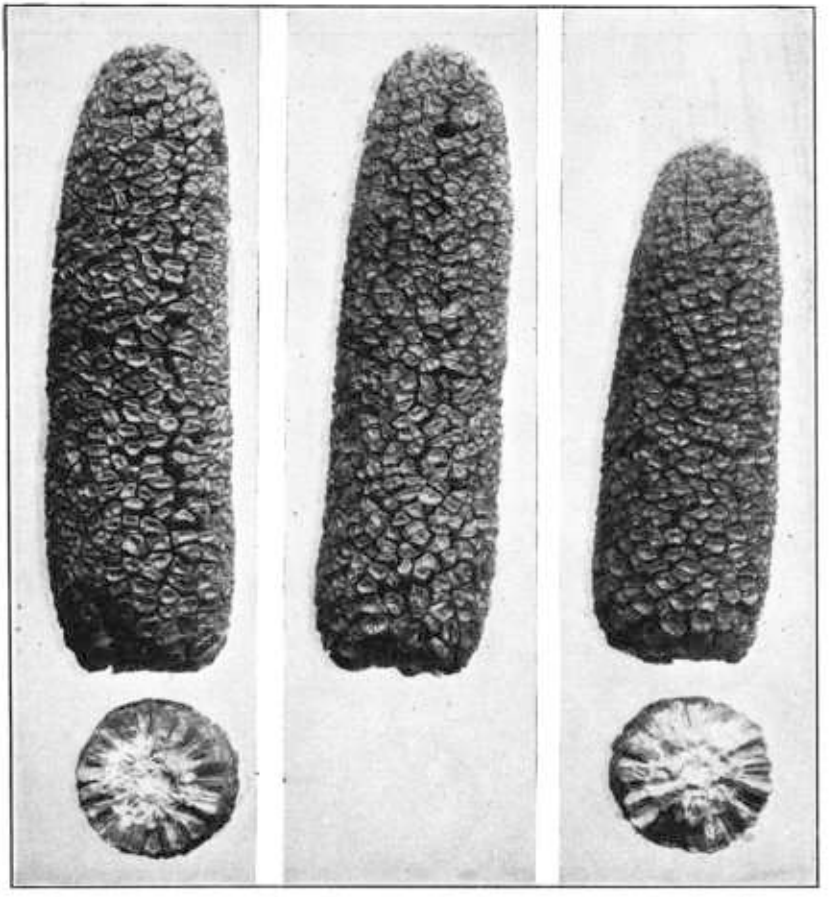

FIGURE 5.—Country Gentleman (Ne Plus Ultra) sweet corn. (One-half natural size.)

GOLDEN BANTAM

The Golden Bantam variety was introduced about 1900. It is somewhat earlier than Crosby and has a stalk not quite so heavy. The ears are cylindrical, 5 to 6 inches long, with eight rows of yellow, broad, shallow, closely wrinkled grains (fig. 7).

This variety first became popular as a home-garden corn. It has since been used extensively as a market-garden corn and in recent years as a canning variety.

Various types have been developed by selection by seedsmen and experiment-station workers. The most pronounced variety has recently been sold as Fourteen-Rowed Bantam, the ear of which is longer and larger but has the same type of grain as the parent sort.

Golden Bantam has been used in intervarietal crosses. Some of these crosses are Golden Bantam × Stowell Evergreen, Golden Bantam × Country Gentleman (called Golden Cream), Golden Bantam × Howling Mob (called Golden Giant), and Golden Bantam × Crosby. These various crosses and their interest to canners everywhere illustrate the present vogue of yellow sweet corn for all purposes.

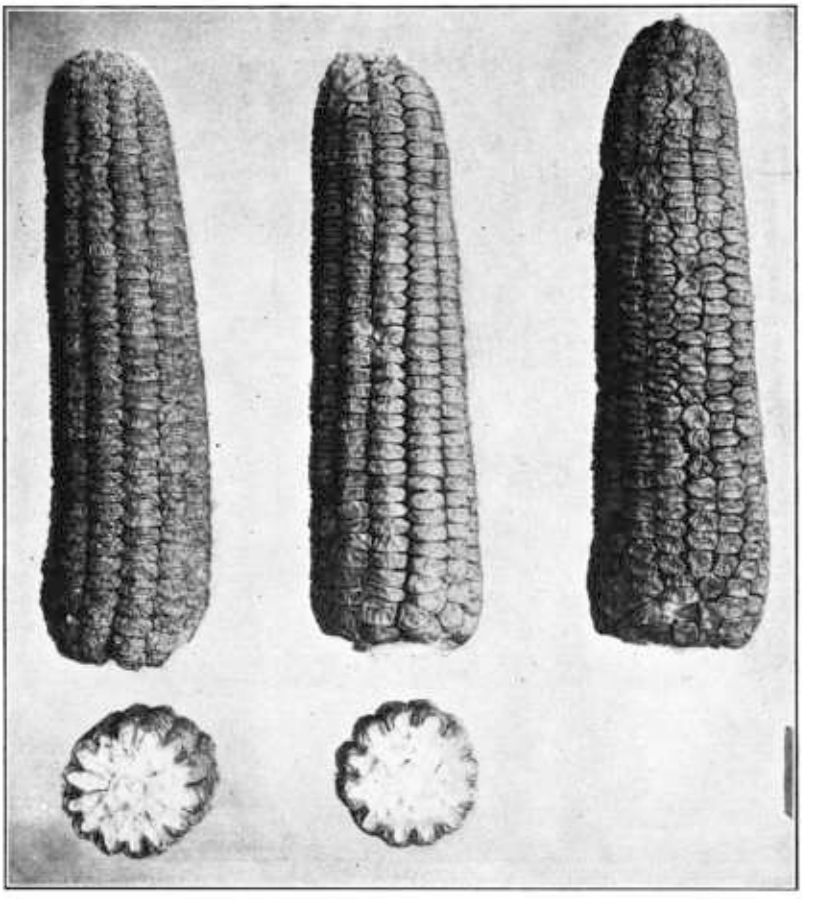

FIGURE 6.—Crosby sweet corn. (One-half natural size.)

PLANTING

GRADING THE SEED

Experimental and practical results have shown it to be desirable to grade sweet-corn seed according to size before planting, and to plant the different grades in separate blocks in the field. The shelled seed is usually passed through a grader which separates it into two sizes, large and small. Many canners who possess pea-cleaning machines have adapted them to the grading of corn, and others have used small seed-corn graders found on the market.

The larger kernels produce a better stand and larger, stronger plants which reach the canning stage two or three days earlier than those from small seed. Planting the two grades in separate blocks in the field gives more uniform stands, and when this method is followed the uniformity of reaching the canning stage within each block is definitely superior to results obtained with seed of mixed sizes. The same planter plates should be used for both sizes of seed even though a larger number of small kernels will be planted. The probability of a poorer stand from the small kernels makes it advisable to plant a larger number. The weight of seed planted per acre will not be materially different.

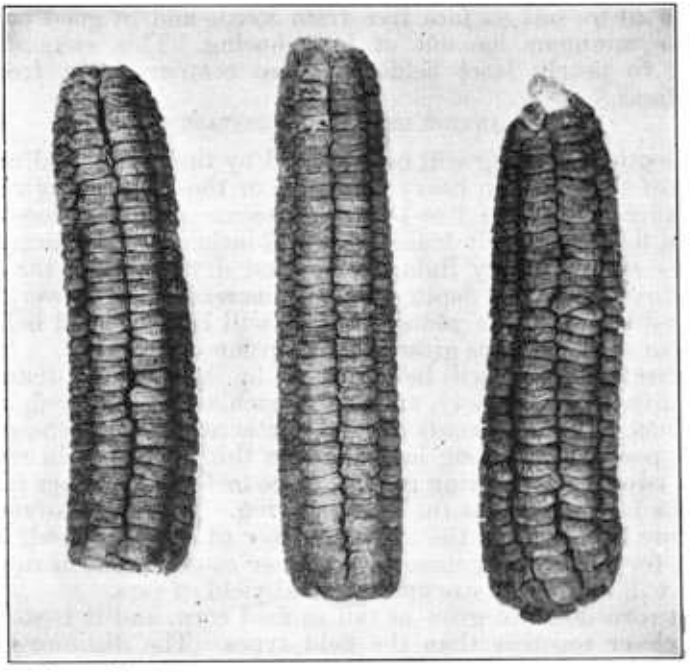

FIGURE 7.—Golden Bantam sweet corn. (One-half natural size.)

TIME OF PLANTING

The planting of sweet corn is ordinarily deferred until warm, settled weather is assured, because of the inability of the seed to germinate properly when placed too early in cold, wet soil. However, in the Prairie States and in those around the Great Lakes it is a common practice on sufficiently dry soils to risk an early planting to insure a crop before the early fall frosts. The best corn is usually the result of moderately early planting combined with good soil preparation. The exact date of planting will vary, and it is normally determined in conference with the factory operator, who seeks a long, uniform maturing of the crop in order to maintain a satisfactory canning schedule.

PLANTING SYSTEMS

Systems followed in the planting of sweet corn for a given locality are usually identical with those of field corn. Drilling the seed so that the plants will stand singly in rows rather than in hills is an accepted practice in some sections. This method of planting may be especially desirable on hillsides or on rocky, stumpy ground, following either the contour or a straight line. When a checkrow planter is used, kernels are dropped in a hill, the number per hill and the interval between hills being regulated by the dropping device of the planter. The hills are so alined that straight rows are formed at right angles to the direction of the planter rows. Since cultivation can be alternated in direction in a "checked" field, the grower can keep the entire soil surface free from weeds and in good condition with the minimum amount of hand-hoeing. This system is best adapted to nearly level fields that are comparatively free from obstructions.

PLANTING DEPTHS AND DISTANCES

The depth of seeding will be governed by the nature and moisture content of the soil. In heavy clay soils or those especially retentive of moisture, a depth of 1 to 1½ inches seems suitable in most localities. In loams or sandy loams, 1½ to 2 inches is recommended, but when the soils are very light, warm, and dry, or when the area is subject to drought, the depth should be increased. However, if corn is planted too deep, the young seedling will be exhausted before the leaves can start vigorous growth above ground.

The rate of seeding will be influenced by the planting distance, by the locality, by the variety, and by the richness of the land, varying from about 10 to 15 pounds of seed per acre. More kernels can be planted per hill on strong land than on thin land, but in most important sweet-corn growing regions three to four stalks per hill have given the best returns at the usual spacing. It may be advisable to drop more kernels than the actual number of stalks desired, to compensate for losses from insects and other causes. Too many stalks per hill will reduce the size and the total yield of ears.

Sweet corn does not grow as tall as field corn, and it is sometimes grown closer together than the field types. The distance between rows and between stalks and hills affects to some degree the yield per acre. Plants spaced too close together give a decreased yield of ears and an increased weight of stover, while if the planting is too sparse both will be reduced. Short-growing and early varieties may be planted 30 to 36 inches apart, and the medium or large-growing varieties, 36 to 42 inches. If the seed is drilled, single stalks should stand 12 to 15 inches apart in the row, and if in hills they should be from 28 to 36 inches apart. Rich soils having ample moisture at the time of the formation of the ears will also bear thicker planting. The proper planting distance is another question that must be answered differently in different localities.

Some canning concerns insist that the grower separate the plantings of white and yellow varieties of sweet corn. Since this crop is wind-pollinated, the white ears may be exposed to cross-pollination with a yellow variety. The kernel color of a yellow-pollen parent becomes evident the same season that the crossing occurs, so that if pollen from a yellow variety reaches the silks of a white variety the

white ears may show some yellow kernels at harvest time. If a yellow variety is exposed to the pollen of a white variety, no effect will be seen in the resulting ears. However, if these ears are used for seed, white-kerneled plants may appear among the yellow planting. When the corn is to be used in the factory the white varieties should be planted some distance away from and to the windward of the yellow strains, because the canner will reject all white ears showing yellow kernels. Whenever sweet corn is grown for seed the two types should be widely separated.

REPLANTING

It is a waste of land and of labor to carry a poor stand through to the harvesting period. Whether to replant or not depends upon whether there will be sufficient time after replanting for the crop to reach proper maturity before frost. As a rule, it does not pay to replant an occasional hill, because of the retarded growth and poor yield resulting from the competition of the adjacent plants. If the stand is so poor that replanting is advisable, the soil should be disked and the whole field replanted. Interplanting between the rows without destroying the old crop results in a weedy replanted crop and is of doubtful value.

CULTIVATION AND CARE

The advantages of early planting may be lost unless it is promptly followed by cultivation, for the growth of the crop may be seriously harmed if a hard soil crust interferes with the emergence of the seedlings, or if weed growth is allowed to rob the crop of moisture and nutrients. Sweet corn does not differ greatly from field corn in its cultural requirements.

Soon after planting, before the corn is up, all weeds that have started should be destroyed by shallow harrowing or by the use of a rotary hoe or other suitable shallow tillage implement. This preliminary cultivating or weeding also breaks up a hard crust that might interfere with the young seedlings. It is a simple, rapid, effective, and inexpensive method of holding weeds in check until the corn is 5 or 6 inches high. Thorough weed control up to this time, by such a method, greatly reduces the cost and increases the efficiency of later cultivation.

Shallow cultivation, as a rule, has proved to be more satisfactory than deep cultivation. Deep culture tends to break the roots of the corn plant, thereby interrupting the absorption of water and plant food. While the plant may produce new roots, this can be done only at the expense of ear and fodder production. Deep cultivation should be used only during the early stages of the growth of the crop and after excessive rains have packed the soil. A shallow soil mulch of from 1 to 2 inches in depth should destroy all weeds without injuring the roots of the crop.

The number of cultivations necessary will depend upon local conditions. The cultivator should be used following a rain as soon as the soil is dry enough to permit stirring without injury to its texture. The soil mulch should be promptly restored to prevent the baking of the surface soil and to destroy weed seedlings before they have become firmly established. If necessary in order to control weeds,

shallow tillage should be continued through the tasseling period. It is sometimes profitable to remove occasional weeds by hand-hoeing even as late as the silking time of the corn. Often the grower will sow a catch crop for late pasturage, covers crops, or winter wheat or rye, to be cultivated into the soil with the last cultivation.

A choice from among the many types of cultivators that are available should depend upon local conditions. The use and advantages of several good types of cultivators are explained in Farmers' Bulletin 1714, Corn Culture.

Removing the suckers from the base of sweet-corn plants is an old practice based on the belief that their removal increases the yield and size of the ear and promotes earliness. Recent experimental work shows that plants suckered early produced no greater number of ears and no higher yield by weight than those not suckered. In fact, they produced very slightly less. Poor returns were obtained when suckering was delayed until the tassels were forming. Under normal conditions, suckering is a practice that cannot be recommended in the growing of corn for canning, because of the labor and expense involved, and because no definite increases in yield result, while definite decreases may result. For those who depend upon stover for livestock it will result in the loss of some feeding material.

HARVESTING

The date of harvesting varies with the locality, the variety grown, the time of planting, and also varies in a single locality from season to season. The kernels should be plump and full of milk and this stage normally coincides with the time when the silks begin to turn dark brown. Some experience is needed in picking the crop, the harvester being guided by the appearance of the silks and by feeling the ears to ascertain the plumpness of the kernels. The ears are snapped in the husk, leaving a short stalk at the base of the ear. Some factories require that the ears be cut with a short butt in order to decrease the weight of waste, part of which might consist of long shanks.

High quality in sweet corn is closely associated with the sugar content of the kernels. During the ripening process the sugar changes rapidly to starch, the kernels passing successively through the premilk, milk, early dough, and dough stages. The corn should be harvested in the milk stage in order to obtain a product of the best flavor and most desirable consistency. If harvested too soon, the yield in tons of ear corn per acre and in cases of canned corn per ton will be low and the canned product will lack body. If harvested late, the product will be lacking in flavor, will be starchy, and will contain tough seed coats.

Sweet corn passes through the milk stage in a very short time. Temperature has been shown to be the most important controlling factor in the rate of ripening. In the most southerly corn-canning regions, or during a period of warm weather farther north, the ears may remain in prime canning condition no longer than 2 days. Under such conditions harvesting must be started promptly at the proper time and completed as rapidly as the factory can handle the corn. Farther north where the summers are cooler, or southward

when the corn is planted to be canned late in the fall, it may remain in good canning condition for as long as 5 or 6 days. Under high temperatures, when ripening is very rapid, the usual test of quality, which consists in squeezing out and examining the contents of the kernel, is a less dependable index than under cool conditions.

Bearing in mind the rapid rate at which sweet corn passes through the proper stage for canning, one can readily understand why uniformly maturing stands are important. Ungraded seed, which may give as much as 2 days' variation in time of reaching the milk stage, obviously would not yield a high-quality, uniform product if the crop were harvested all at one time. In order to obtain good quality it would be necessary to harvest the field repeatedly, which is expensive, and even then the product would be lacking in uniformity.

The ripening process in green sweet corn continues after it is harvested, and the quality deteriorates rapidly. High temperature hastens this condition very markedly. Piles of corn at the factory or even loads of corn on wagons soon begin to heat, and a great loss in flavor results.

Sweet corn is usually harvested in the morning so that it may be handled at the factory without delay. Harvesting late in the day often gives rise to congestion at the factory, with the result that the corn deteriorates in quality before it can be placed in the cans. Most sweet-corn fields are harvested but once, an exception being made in years of low yields or in the case of unevenly maturing plantings, when the fields may be gone over two or three times. The nubbins and the green ears are left on the stalk.

YIELDS

The yield of sweet corn depends upon the variety and the conditions under which it is grown. This latter factor includes the soil, its preparation and fertilization, the rate of seeding, and the distance of planting, the efficiency of cultivation, weather conditions, and the effects of weeds, disease, and insect pests.

Although the yield of sweet corn grown for a canning crop in the United States during the period from 1926 to 1929 averaged 2.07 tons per acre, yields may range from one-half ton to 8 tons per acre. A yield of 4 tons is not unusual.

FACTORY WASTES

Canning-factory wastes, including the husks, shanks, silks, and cobs of sweet corn, were formerly considered worthless and were left in piles to decompose or were hauled away to a dumping ground at considerable expense. On the basis that from 600 to 900 pounds of canned corn is obtained from 1 ton of sweet corn as delivered, the canning concern must consider the disposal of wastes amounting to from 55 to 70 percent of the original material. These wastes are now considered a valuable byproduct, but in some regions this material is being neglected because its feeding or manurial value is not fully appreciated.

SWEET-CORN WASTE AS SILAGE

Many of the larger factories are equipped with a silo or a battery of silos in which to conserve the sweet-corn wastes (fig. 8). Some-

times only the husks are made into silage, and since they may ferment too rapidly the action is often retarded by mixing some drier material, such as oat straw or dry fodder from the field, with the greener material. The cobs have sometimes proved unsatisfactory when used whole. A part of the failure in making sweet-corn silage is probably due to the fact that whole cobs from the factory do not pack tightly into the silo. The presence of air in unpacked silage

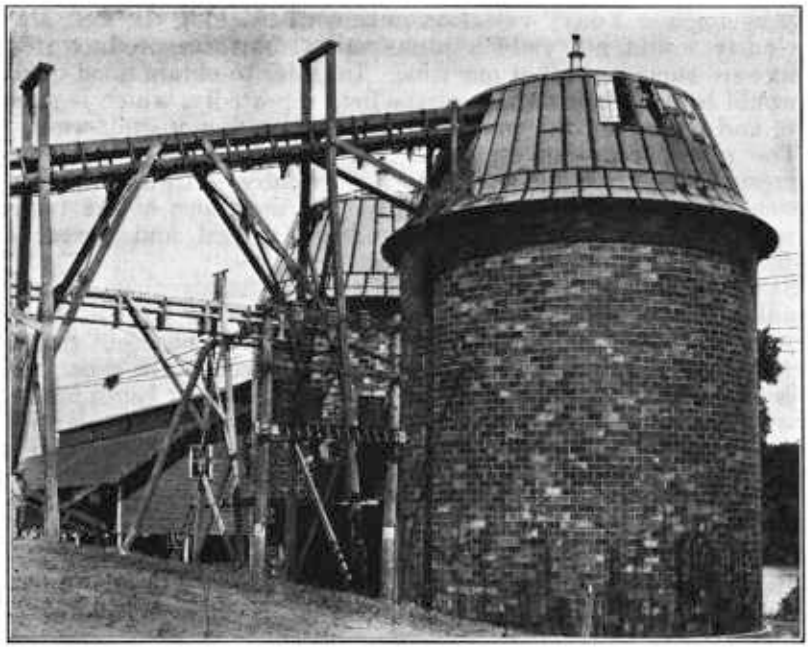

FIGURE 8.—Silos used for preserving the husks and other waste from sweet corn.

prevents the proper preservation of the material. Some operators run the cobs through silage cutters or shredders so that the mass will pack to better advantage. Silos for the individual grower are common in dairy and livestock-feeding sections, and frequently a part of these factory wastes is obtained by agreement and ensiled on the farm.

Some canning firms pile their corn wastes in large stacks, covering the accumulation of pea vines and other material obtained earlier in the season. These stacks may be of any size or shape and are frequently as large as 80 feet long, 20 feet wide, and as high as it is convenient to make them. Care is taken in forming these stacks by maintaining a steep pitch to the sides and thoroughly trampling the mass to exclude the air and to insure proper fermentation. A ditch is usually made around the edges of the refuse piles to carry away the liquid seepage that oozes from them. This liquid should not be placed on farming land, for it has an injurious effect on the crops because of its souring, fermentative action.

Most contracts contain a statement providing that the corn husks and cobs are to belong to the factory. The canner may allot a reasonable quantity for immediate feeding during the canning season or

may reserve the fresh and ensiled material for his own feeding operations, or he may distribute the cobs, retaining only the husks. Often the factory sells the silage to the producers and, in case of surplus, to other feeders of livestock.

FACTORY WASTES AS MANURE

The factory wastes have some fertilizing value as manure. Husks, especially the completely decomposed outer layers of the stack, have been used as orchard mulch. Although the practice is not always advisable, cobs have been spread on heavy clay spots in fields in layers about 6 inches deep. During the first year after plowing under the results proved discouraging because of the slowness of decomposition, but after a second season the land became friable and mellow, bringing the soil nearer to desirable cultural conditions. The husks decompose more rapidly than the cobs, but are seldom used because of their greater value as silage. It will perhaps be better if this roughage is first fed to stock, as only a portion of the fertilizing constituents need be lost in animal feeding. Then if the manure is given protection from weathering and losses from seepage, a double value will be obtained, first from the palatable fodder and later in the use of the manure.

DISEASES[3]

Root rots cause great losses in sweet corn, especially in the field-corn regions. Infection of a crop may occur from diseased seed or from soil that contains the organisms. In either case the corn crop gives reduced yields, irregular growth and maturity, barren stalks or stalks bearing nubbin ears, and plants that die prematurely. Experimental work shows that the infection of seed may be considerable and that it pays to test all seed stock and to discard that seriously infected. The grower should select disease-free ears. If there is any question as to freedom from disease, the seed should be treated with one of the organic mercury dusts recommended for seed treatment. The rotation of crops and the maintenance of a highly fertile condition of the soil will keep down to some extent the amount of damage if the soil becomes infested.

Smut is a widely distributed disease, attacking the stalks, ears, and tassels of the sweet-corn plant. The organism produces irregular galls or outgrowths, covered at first with a white membrane, but later breaking open and scattering masses of spores. The smut fungus will infect at any actively growing point or fresh wound on the plant at any period during the growth of the crop. In valuable plots the amount of damage can be reduced by cutting away and burning all smutted parts before the smut galls are mature. Treatment of the seed to prevent smut is of no avail. Rotation of crops should be practiced, and land should not be top-dressed with manure or refuse matter produced from the feeding of smut-infected corn stover to livestock. The ensiling of corn is said to destroy the smut spores.

Ear rots are caused by several fungi and produce imperfectly developed ears which are soft and often covered with a mold. The ear rots are of importance chiefly where sweet corn is grown for seed. The trouble is more serious in moist, warm weather. Control meas-

[3] Prepared by A. G. Johnson, principal pathologist, and Charlotte Elliott, associate pathologist, Division of Cereal Crops and Diseases, Bureau of Plant Industry.

ures include the practice of a rotation, clean cultivation, and the use of disease-free seed or seed of disease-resistant strains.

Bacterial wilt or Stewart's disease of sweet corn occurs every year in the Middle Atlantic States, where only resistant varieties can be grown to advantage. In most years the disease is unimportant in other sweet-corn-growing sections. Following a series of mild winters the disease occasionally causes serious losses throughout the Corn Belt and may spread into the Northern States and Canada. The bacteria live over winter in one of the corn flea beetles and are carried to the young corn plants upon which the beetles feed. Throughout the season the beetles spread the disease by carrying the bacteria from diseased to healthy plants. Long, light-yellow streaks develop in the leaves, bacteria fill the vessels or water-conducting fibers of the stalk and ooze out as yellow beads from the cut ends. Plants may wilt and die or remain stunted, develop premature tassels, and bear nubbins or no ears at all. Golden Bantam and other early varieties are most susceptible. Late-maturing varieties are resistant. Resistant strains of Golden Bantam and other early varieties have been developed recently in cooperative studies carried on by the Department of Agriculture and the experiment stations, and by the stations and other agencies which offer an effective means of control.

For detailed information concerning these or other disease troubles, communicate with the State agricultural experiment station or with the Bureau of Plant Industry, United States Department of Agriculture.

INSECTS[4]

Many species of insects are known to be injurious to Indian corn, and practically all of these attack sweet corn. Some of these cause damage such as to reduce materially the yield and quality of the product. Among the more important insect pests of this group are the following: Corn earworm, European corn borer, common cornstalk borers, webworms, armyworm, army cutworm, fall armyworm, chinch bug, green bug, corn-leaf aphid, corn-root aphid, white grubs, leafhoppers, grasshoppers, wireworms, seed-corn maggot, and southern corn-root worms.

The control of these pests in sweet corn for the most part is similar to the control for such insects in field corn. However, the control measures differ somewhat because of the variation in cultural practices and more particularly in the value of the crop per acre. Information is usually available on the biology and control of most of these insects, and although the damage caused by various species may look the same, the control measures are usually different for the various species in the same locality and even the same species in different parts of the country.

When injury is observed and information is desired, specimens of the insect causing the damage and a sample of the injured plant should be sent either to the State agricultural experiment station or to the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture.

[4] Prepared by W. H. Larimer, principal entomologist, Bureau of Entomology and Plant Quarantine.

U. S. GOVERNMENT PRINTING OFFICE: 1936

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